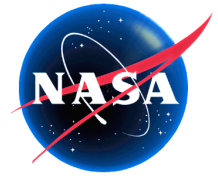


Universal Space Network Services

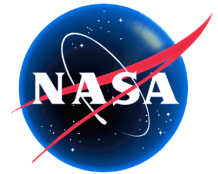
GS SDR Section 9

Ross Cox
Ground System Engineer



USN Overview - Why USN?

- ▶ ***The GLAST Mission needs USN because:***
 - *Ku-band System must outgas for two days after launch*
 - *We need a way to get the housekeeping data from the recorders right after launch*
 - *In the event of an anomaly, pointing may not be sufficient for Ku-band support*
 - *USNs Hawaii and Dongarra sites are convenient to our orbit*
 - *Good coverage every day.*
 - *SWIFT Experience*



USN Overview

► **Link Rates**

– *Telemetry*

- 20 Mbps SCI PB
- 2.5 Mbps HK PB
- 51 kbps Real Time HK
- 1 kbps Real Time Alerts

– *Command*

- 2 kbps

► **Tracking**

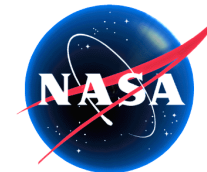
- *No Tracking Required*

► **Scheduling interface**

- *E-mail Interface*

► **System Features**

- *Requires two strings of equipment*
- *Pay per pass support structure*
- *Good coverage for long duration passes from two stations*
- *Leverage existing equipment*
- *Possible loading conflict with other missions*

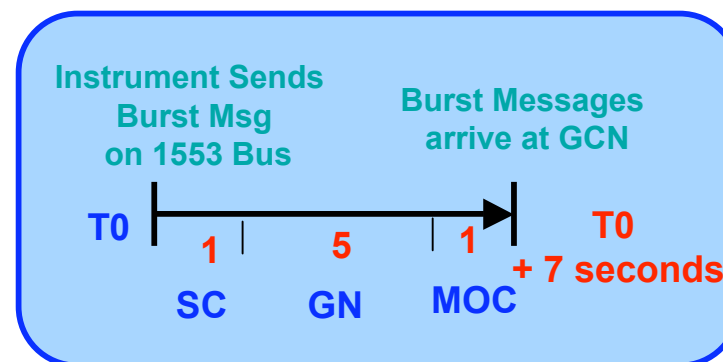
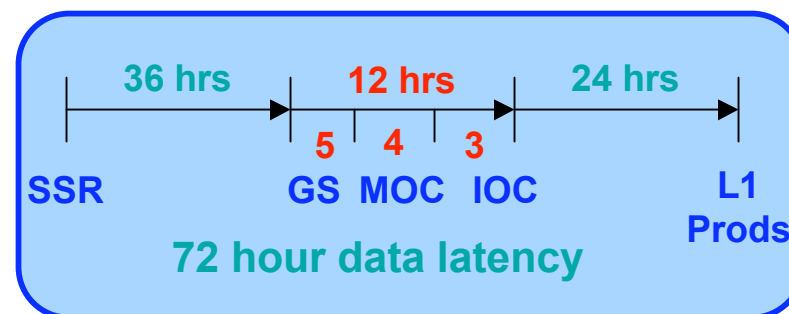


Requirements Summary

► Key Requirements

- Provide PB data within 5 hours from sites to MOC 80% of the time
- Processing Alerts as part of real time stream within 0.5 seconds, 95% of the time
- Support Automated MOC for RT and PB data acquisition
- Station call-up with 15 minutes for spacecraft emergencies

- Subject to view constraints

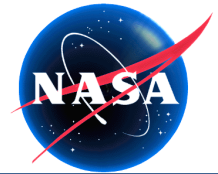


► USN Existing Vs New Capabilities

- Existing Commercial Network
- No new capabilities are required



USN Sites



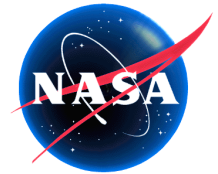
PrioraNet Worldwide Network of Ground Stations



 PrioraNet Stations  Collaborative Stations*  Network Management Centers  Future Stations



USN Western Australia Remote Ground Station



Western Australia RGS

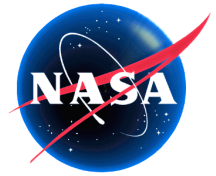
- ❖ **Dongara**
- ❖ **BAE Systems Australia Sub to USN**
- ❖ **S/X/Ku-Band 13 Meter Support**
- ❖ **Automated Operation**
- ❖ **Redundant Components**





Charles "Pete" Conrad

Remote Ground Station



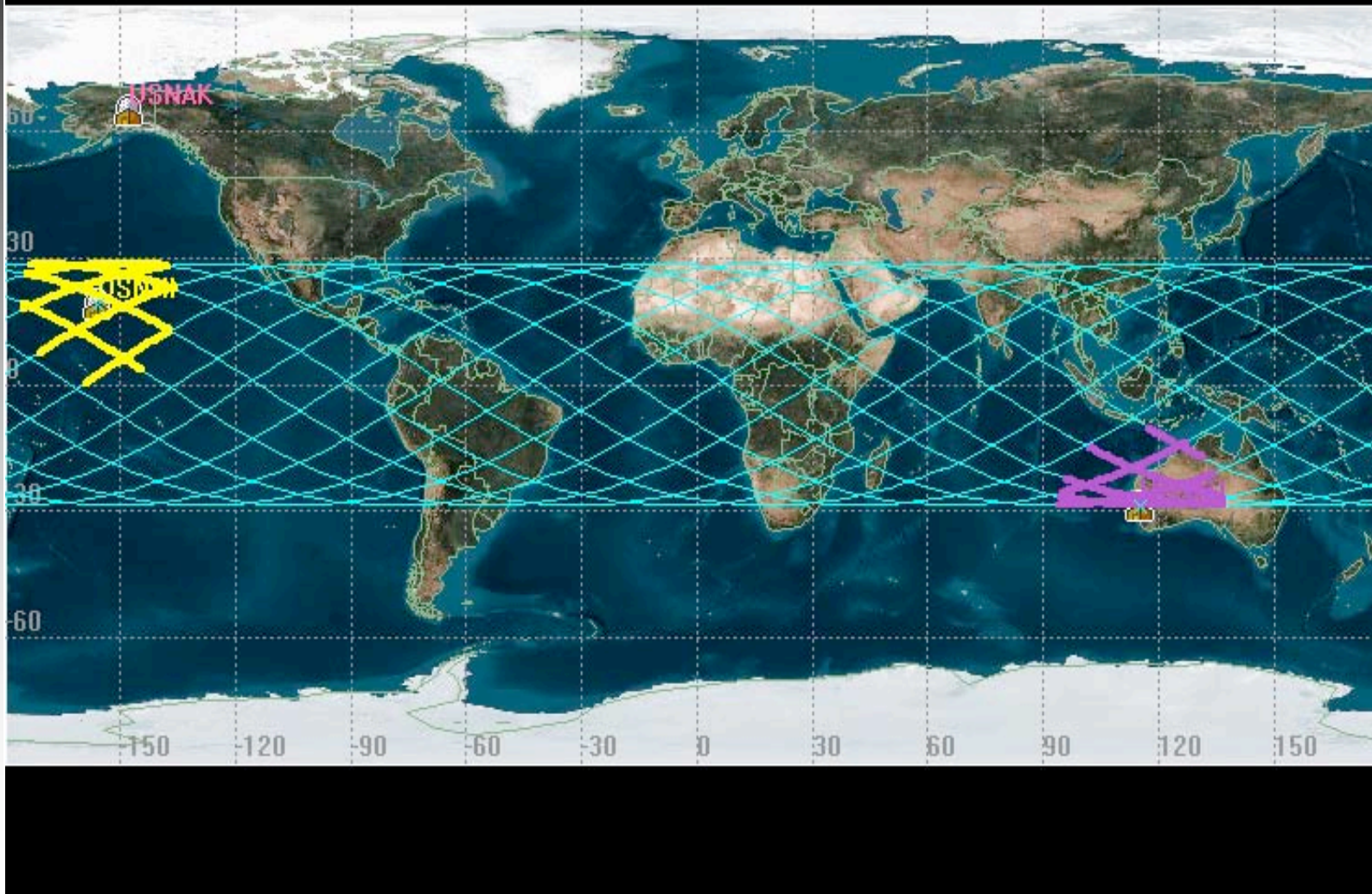
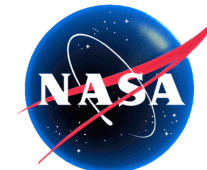
Hawaii RGS

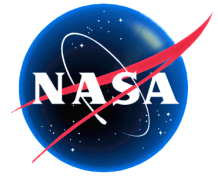
- ❖ South Point, Hawaii
- ❖ S/X/Ku-Band 13-Meter Support
- ❖ S-Band 3.5 Meter Support
- ❖ Automated Operation
- ❖ Redundant Components





GLAST Coverage Area



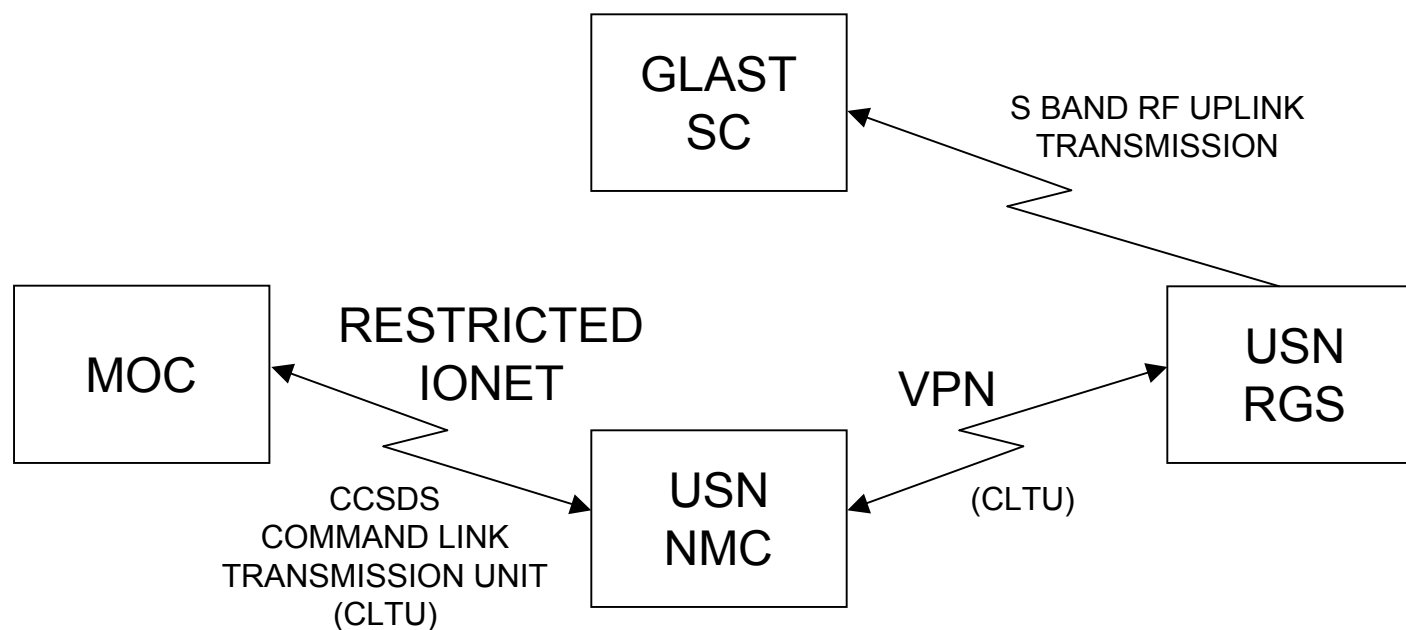
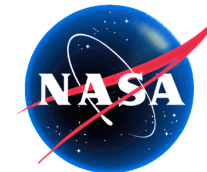


GLAST Uplink RF Requirements

- ▶ **Frequency** **2106.4 MHz**
- ▶ **Modulation** **BPSK/PM**
- ▶ **Subcarrier Frequency** **16 kHz**
- ▶ **Modulation Index** **1.0 radian**
- ▶ **Data Rate** **2.0 Kbps**
- ▶ **Symbol Rate** **2.0 Ksps**
- ▶ **Data Format** **NRZ-M**



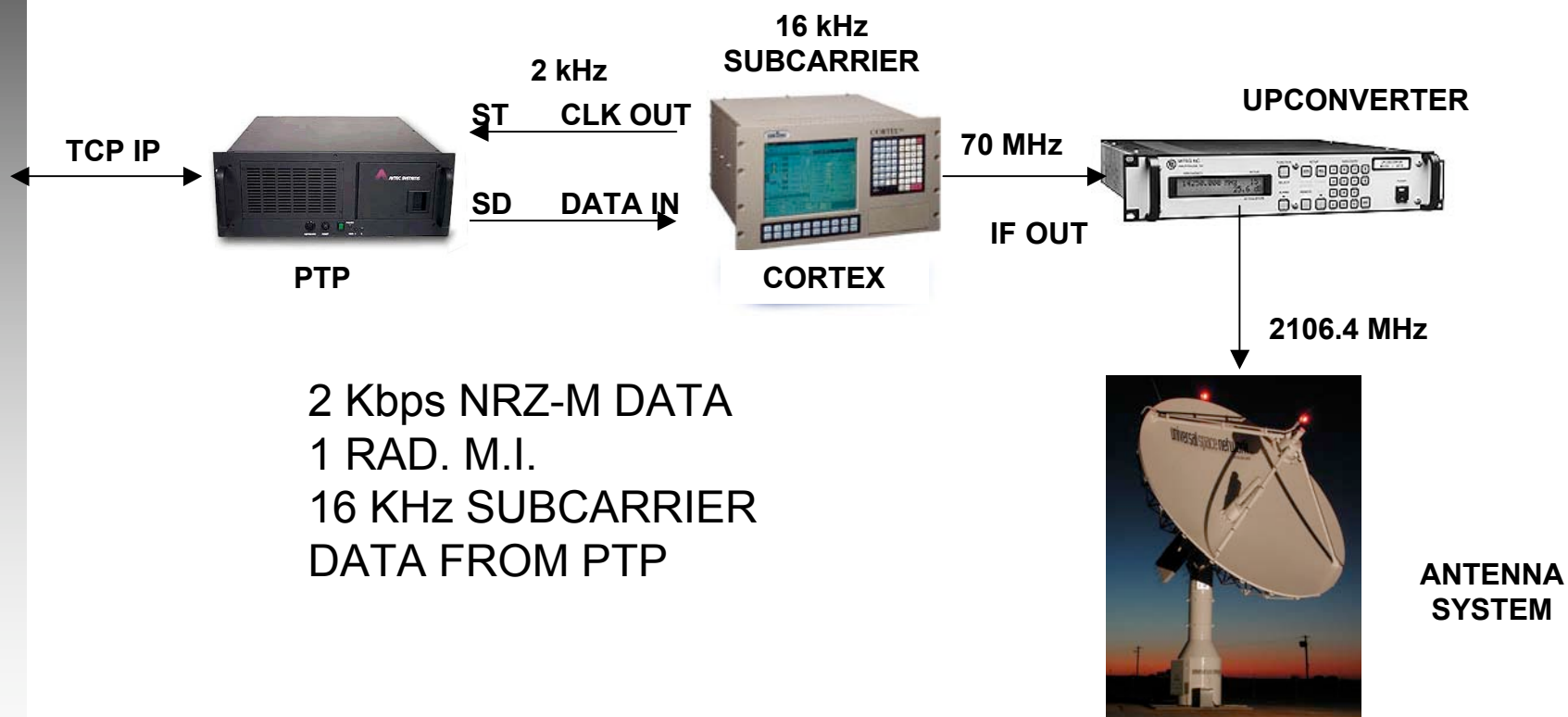
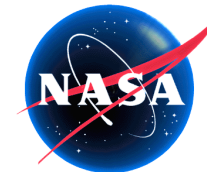
Uplink TC Path

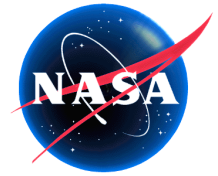




Uplink Configuration

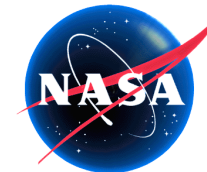
Remote Ground Station



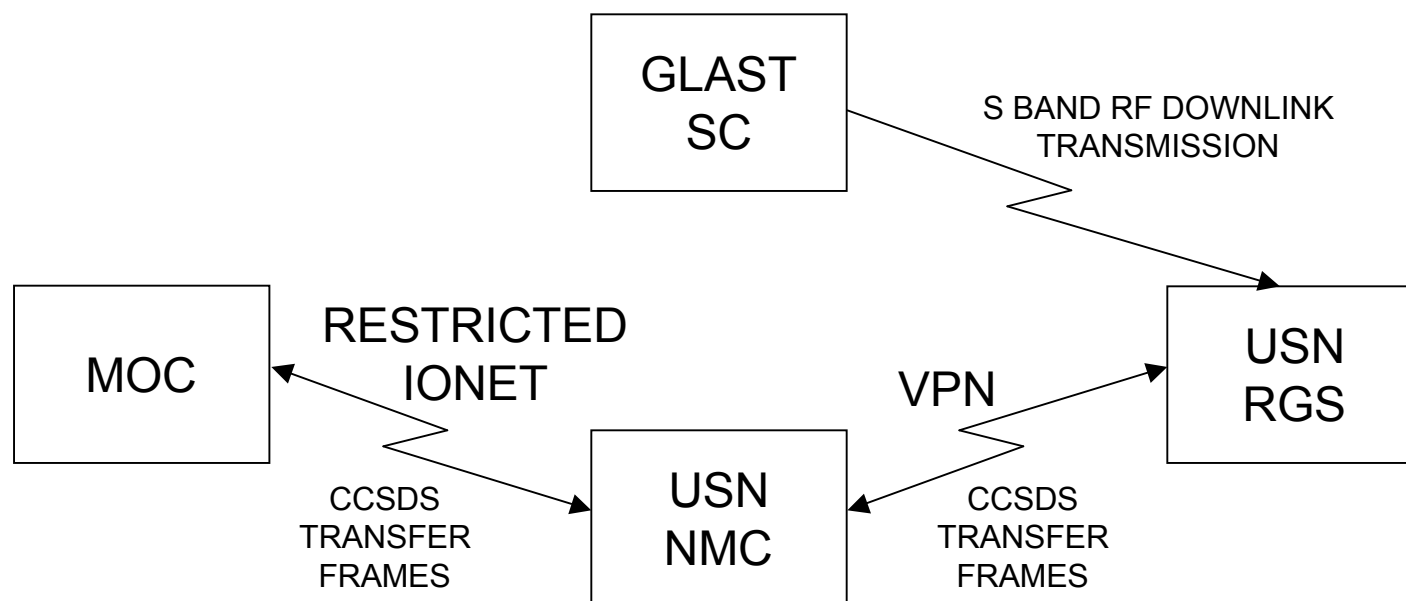


GLAST Downlink Requirements

- ▶ **Frequency** **2287.5 MHz**
- ▶ **Modulation** **OQPSK**
- ▶ **Data format** **NRZ-M**
- ▶ **Data Type** **Telemetry**
- ▶ **Data Rate** **2.5 Mbps**
- ▶ **Coding**
 - Convolutional Coding Rate _
 - Reed Solomon 223,255



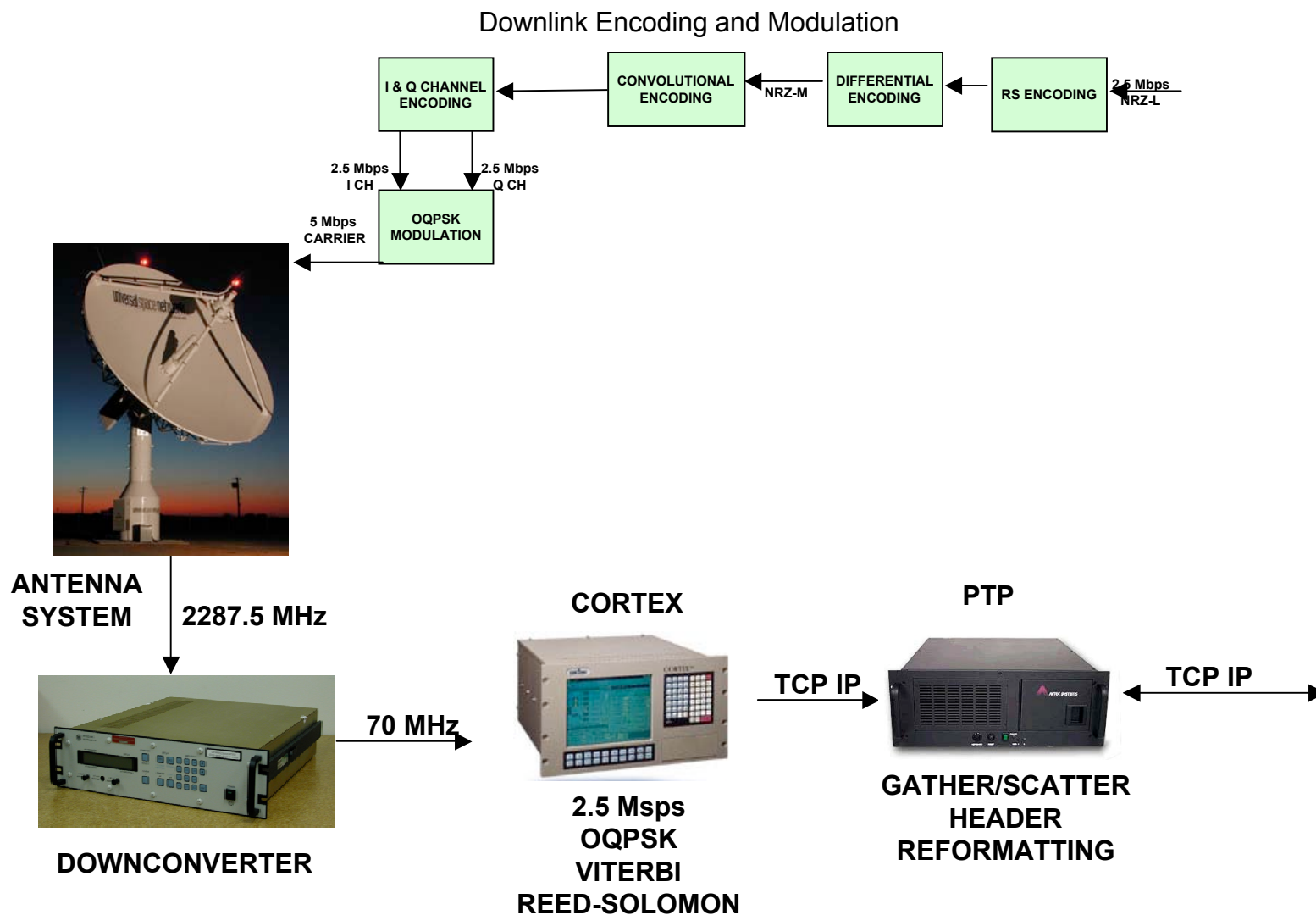
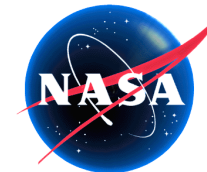
Telemetry Downlink Path

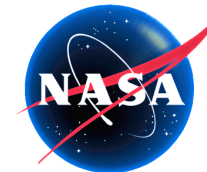




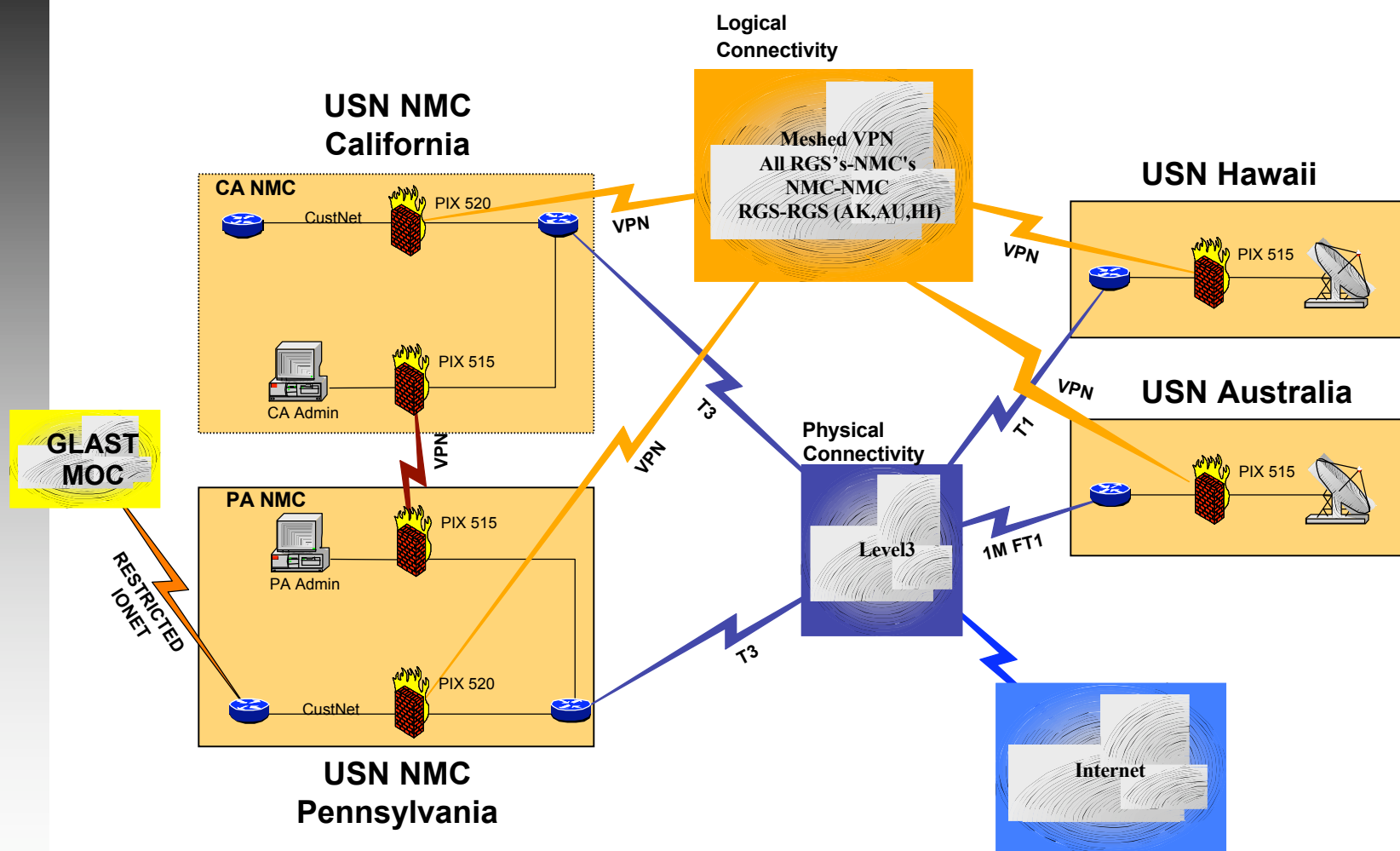
Downlink Configuration

Remote Ground Station



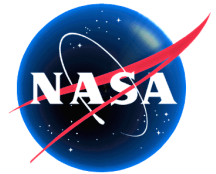


Network Connectivity





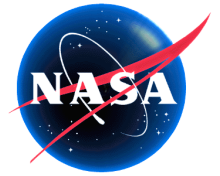
Networking



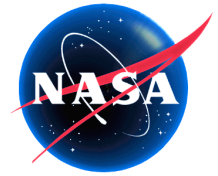
- ▶ **Two Fully redundant Network Management Centers (NMC) in Newport Beach, CA and Horsham, PA. NMC's are connected to Level-3's managed IP backbone via DS-3 (up to 45Mbps) circuits.**
- ▶ **Multiple Remote Ground Stations (RGS) connected to Level-3's managed IP backbone via T1 and E1 (1024 to 2048Mbps) circuits.**
- ▶ **Standardized on Cisco equipment for Routers, VPN's and Firewalls.**
- ▶ **All NMC's and RGS's are interconnected via a meshed VPN configuration. VPN's are based on Cisco hardware and software utilizing standards based IPSEC 3DES encryption.**
- ▶ **Meshed VPN configuration provides "closed" WAN environment.**



Networking – Customer Interface



- ▶ **The DMS uses the FastCopy/Fest application by Softlink**
 - Guaranteed file delivery including automatic/manual recovery from the actual point of failure
 - Extensive logging
 - Several data verification methods
 - Authentication and strong encryption
 - Scheduling and hold/resume functions
 - Compression capability



USN Operations Overview

► **Scheduling**

- Schedule Requests submitted via Email
- 7-day schedules released by USN
- USN Scheduling Conflict Resolution Process when USN backup equipment is used.
 - Priority to LEOP and Spacecraft emergencies.

► **Orbit Ephemeris Updates**

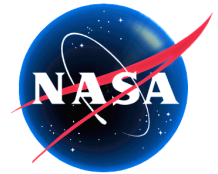
- FTP-Pull of TLE data files from MOC or NORAD

► **Mission Operations Support Documentation**

- Mission Support Plan
- Network User's Manual - (MSP and Ground Network ICD provide info)

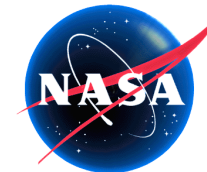
► **Operations Reporting**

- Daily Status Reports
- Monthly Mission Status Reports



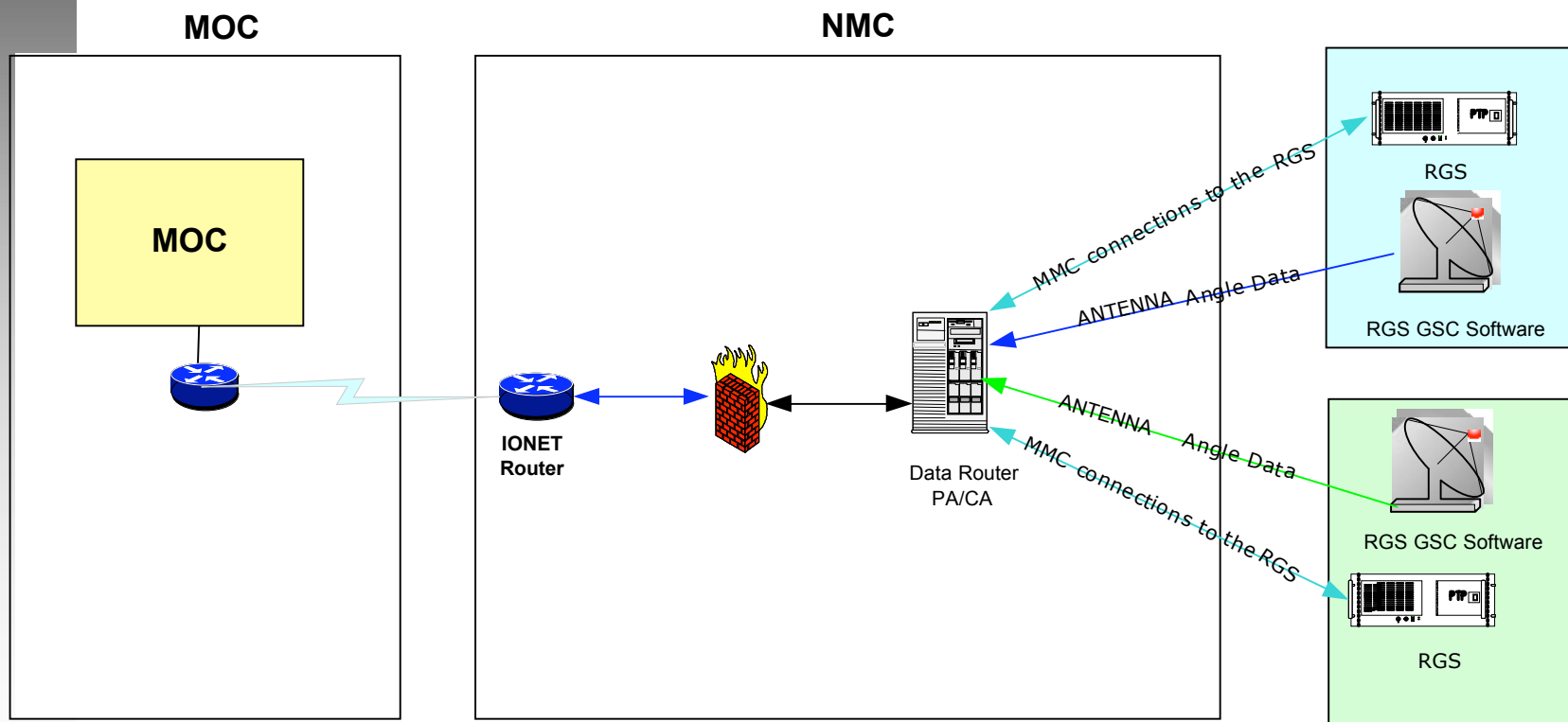
Testing

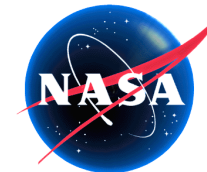
- ▶ **USN is prepared to provide equipment and personnel to meet all mission requirements prior to launch.**
 - RF Compatibility tests
 - GRTs
 - End to End
 - Launch Rehearsals
- ▶ **CDRLS such as a Mission Support Plan, Ground Station Configurations and Ground Network ICD can be supplied as required.**



USN System Testing

- *Integrated System Testing*
 - *Part of GLAST Ground System Test Plan*
 - *Used for testing with MOC*





Documentation

- ▶ **MOC – USN**
 - *MOC establishes ICD and Ops Agreement with USN*
- ▶ **Spacecraft-Ground ICD**
 - *Spectrum establishes this ICD*
 - *It is applicable to both sites*



Schedule



- ▶ **All USN Circuits in place 3/05**
 - CSR by 8/20/04
- ▶ **Testing commences 7/05**



Universal Space Network Services Backup Slide



Downlink Processing

